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# PATENT ABSTRACTS OF JAPAN

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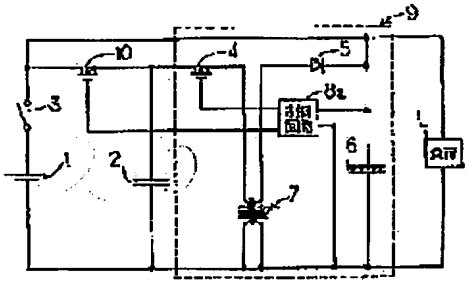
TAMURA KOKI

## (54) POWER SUPPLY




(57)Abstract:
PROBLEM TO BE SOLVED: To utilize the accumulated energy of an electric double layer capacitor effectively, and besides, to charge the electric double layer capacitor by a secondary battery, in a power unit which utilizes the electric double layer capacitor and the secondary battery as a power supply.
SOLUTION: Power is supplied from an electric double layer capacitor 2 to load L via a DC-DC converter 9 controlled so that the output voltage may be constant. A circuit which charges the electric double layer capacitor 2 by the secondary battery 1 includes a switching element 10 for charge control. A charge current is let flow to the electric double layer capacitor 2 during ON period by turning on or turning off the switching element 10, according to the control signal from the control circuit 8a. The control circuit 8a outputs a control signal to charge the electric double layer capacitor 2 by turning on or turning off the switching element 10 for charge control without hindering the electric double layer capacitor from supplying power to load L.

capacitor which used dielectrics, such as a ceramic. In the electric double layer capacitor announced from each company recently, there is a thing of several 100F to 1000 and hundreds F. These have small internal resistance, high current discharge is possible for a short time, and power density serves as maximum number 1000 W/kg, and is farther [ than a rechargeable battery ] excellent in this point. Moreover, since a chemical reaction does not follow on charge and discharge, the life engine performance at the time of a charge-and-discharge cycle is also excellent, and the engine performance hardly deteriorates on anticipated-use conditions. Thus, by still comparing with a rechargeable battery, although it is the electric double layer capacitor which has many advantages to a rechargeable battery, and large-capacity-ized, since the energy density is low, the fault that capacity is small remains in the power application.

[0005] Thus, although an energy density is high, the attempt which is going to pull out a new property as a high Brit-ized power source is already made combining a rechargeable battery with low power density, and both with the completely reverse property of an electric double layer capacitor. For example, as it is in JP,4-340328,A, there is a thing of enabling boosting charge and large power discharge, by connecting both rechargeable battery and electric double layer capacitor to juxtaposition to a load. Moreover, as it is in JP,4-112631,A, there is a thing of connecting to juxtaposition a rechargeable battery and the electric double layer capacitor which used the organic solution system electrolytic solution.

[0006]

**[Problem(s) to be Solved by the Invention]** Although the terminal voltage under discharge of a rechargeable battery is almost fixed, the terminal voltage of an electric double layer capacitor descends by discharge. Since two prior ******** described previously were carrying out parallel connection of a rechargeable battery and the electric double layer capacitor simply to the load and the terminal voltage of an electric double layer capacitor was always equal to the terminal voltage of a rechargeable battery, the electric double layer capacitor could not discharge an electric double layer capacitor by the discharge overvoltage fall of a rechargeable battery, but had the difficulty that the target effectiveness is not fully acquired.

[0007] Then, the applicant proposed making the most of the are recording electrical energy of an electric double layer capacitor by arranging a DC-DC converter between

an electric double layer capacitor and a load, and holding the electrical potential difference impressed to a load to the value of a certain amount of period regularity, by Japanese Patent Application No. No. 252269 [ seven to ] which applied on September 29, Heisei 7, as the current of a certain amount of period predetermined value can be supplied to a load from an electric double layer capacitor. When using it by the device which does not have the exclusive power source which charges an electric double layer capacitor for the power unit proposed previously, there was a problem that it was difficult to carry out the recharge of the electric double layer capacitor.

[0008] The purpose of this invention is the power unit which uses an electric double layer capacitor and a rechargeable battery as a power source, and it is to offer the power unit which supplies electric power to a load appropriately with a rechargeable battery, and can charge an electric double layer capacitor while it can use effectively the are recording electrical energy of an electric double layer capacitor.

[0009] Other purposes of this invention are offering the power unit which can charge an electric double layer capacitor with a rechargeable battery, without affecting the electric supply to a load from a rechargeable battery, and discharge from an electric double layer capacitor.

[0010]

**[Means for Solving the Problem]** This invention supplies power to a load from an electric double layer capacitor through the DC-DC converter controlled so that output voltage becomes fixed for the power unit with which an electric double layer capacitor is charged by the rechargeable battery including an electric double layer capacitor and a rechargeable battery as a power source, in order to solve the above-mentioned technical problem.

[0011] When a DC-DC converter is in operating state, the electrical potential difference impressed to a load is held to the value of a certain amount of period regularity, and a current is supplied to a load from an electric double layer capacitor. Thereby, operating voltage width of face of an electric double layer capacitor can be enlarged, and the electrical energy which the electric double layer capacitor is storing is used effectively. And after ending the discharge from an electric double layer capacitor, while a DC-DC converter will be in non-operating state and supplies a current to a load from a rechargeable battery, a rechargeable battery charges an electric double layer capacitor. Thereby, the recharge of the electric double layer

capacitor is carried out, and it becomes again usable.

[0012] Moreover, an electric double layer capacitor is charged by the rechargeable battery including an electric double layer capacitor and a rechargeable battery as a power source, and this invention is aimed at the power unit which supplies power to a load from an electric double layer capacitor through the DC-DC converter controlled so that output voltage becomes fixed. And the charge circuit which charges an electric double layer capacitor by using a rechargeable battery as a power source turns on and off the switching element for charge control according to the control signal outputted from a charge control means, and passes the charging current from a rechargeable battery to an electric double layer capacitor at a "on" period.

[0013] Without checking supplying power to a load from an electric double layer capacitor through a DC-DC converter, a charge control means outputs a control signal so that the switching element for charge control may be made to turn on and off and the charging current can be passed from a rechargeable battery to an electric double layer capacitor.

[0014] If the rechargeable battery and the electric double layer capacitor are connected to juxtaposition, the electrical potential difference of an electric double layer capacitor does not fall below on the electrical potential difference of a rechargeable battery, and cannot fully discharge stored charge of an electric double layer capacitor. If the switching element for charge control is prepared in a charge circuit, while making this switching element into the OFF state, an electric double layer capacitor can discharge without being influenced of a rechargeable battery. And if the switching element for charge control is made into an ON state and an electric double layer capacitor is charged with a rechargeable battery at this time since the discharge from an electric double layer capacitor is suspended when the switching element for voltage adjustment of a DC-DC converter is in an OFF state, an electric double layer capacitor can be charged, without affecting discharge from an electric double layer capacitor. The recharge of the electric double layer capacitor can be carried out without affecting supply of the power from a rechargeable battery to a load, since the switching element for charge control can be made to be able to turn on and off and the recharge of the electric double layer capacitor can be carried out in consideration of the supply situation of the power from a rechargeable battery to a load, while making a DC-DC converter into non-operating state and supplying power to the load from the rechargeable battery.

[0015] Moreover, in this invention, the charge circuit which charges an electric double layer capacitor by using a rechargeable battery as a power source including the switching element for voltage adjustment by which on-off control is carried out since a DC-DC converter fixes output voltage shall be turned on and off according to the control signal outputted from a charge control means, and shall contain in a "on" period the switching element for charge control which passes the charging current at an electric double layer capacitor from a rechargeable battery. And a charge control means is good to make it output a control signal so that it makes the switching element for charge control into an OFF state when the switching element for voltage adjustment of a DC-DC converter is in an ON state, and the switching element for charge control may be made into an ON state, when the switching element for voltage adjustment is in an OFF state.

[0016] Since the switching element for charge control will be turned on and an electric double layer capacitor will be charged with a rechargeable battery when the switching element for voltage adjustment of a DC-DC converter is in an OFF state and the discharge from an electric double layer capacitor is suspended if it does in this way, an electric double layer capacitor can be charged without affecting discharge from an electric double layer capacitor. Moreover, while a DC-DC converter is in non-operating state and supplies power to the load from the rechargeable battery, the switching element for charge control is turned on, and carries out the recharge of the electric double layer capacitor with a rechargeable battery.

[0017] As for the control signal outputted from a charge control means, it is desirable to use the control signal which controls the switching element for voltage adjustment, and the thing which the phase has reversed. If it does in this way, a charge control means can be constituted using a part of control circuit of a DC-DC converter. Moreover, it can prevent certainly that the switching element for voltage adjustment of a DC-DC converter and the switching element for charge control are turned on to coincidence.

[0018] A charge control means is good to make it output a control signal with which the ON state of the switching element for charge control becomes short, and the ON state of the switching element for charge control becomes long when the discharge current is small, when the discharge current which flows for a load from a rechargeable battery when a DC-DC converter is in non-operating state is large. If it does in this way, the recharge of the electric double layer capacitor can be carried out

without affecting supply of the power from a rechargeable battery to a load.
[0019] Furthermore, it is aimed at the power unit which power is supplied [ power unit ] to a load from a rechargeable battery through the 2nd DC-DC converter controlled so that power is supplied to a load from an electric double layer capacitor through the 1st DC-DC converter controlled so that, as for this invention, an electric double layer capacitor is charged by the rechargeable battery, including an electric double layer capacitor and a rechargeable battery as a power source and output voltage becomes fixed and output voltage becomes fixed, and operates alternatively the 1st DC-DC converter and the 2nd DC-DC converter. And the charge circuit which charges an electric double layer capacitor by using a rechargeable battery as a power source, including respectively the switching element for voltage adjustment by which on-off control is carried out in order that the 1st and 2nd DC-DC converters may make output voltage regularity shall be turned on and off according to the control signal outputted from a charge control means, and shall contain in a "on" period the switching element for charge control which passes the charging current at an electric double layer capacitor from a rechargeable battery.
[0020] and when the 1st DC-DC converter is in operating state, a charge control means When the switching element for voltage adjustment of the 1st DC-DC converter is in an ON state, the switching element for charge control is made into an OFF state. A control signal is outputted so that the switching element for charge control may be made into an ON state, when the switching element for voltage adjustment is in an OFF state. When the 2nd DC-DC converter is in operating state When the switching element for voltage adjustment of the 2nd DC-DC converter is in an ON state, the switching element for charge control is made into an OFF state. When the switching element for voltage adjustment is in an OFF state, it is made to output a control signal so that the switching element for charge control may be made into an ON state.
[0021] If it does in this way, each switching element for voltage adjustment of the 1st and 2nd DC-DC converters and the switching element for charge control will not be turned on to coincidence, and charge actuation of the electric double layer capacitor by the rechargeable battery will not affect supply of the power to a load.

[0022]

**[Embodiment of the Invention]** Hereafter, the gestalt of operation of this invention

is explained with reference to a drawing.

[0023] In drawing 1 , 1 is a rechargeable battery, 2 is an electric double layer capacitor, and while parallel connection of both is carried out through a switch 3, parallel connection of them is carried out to Load L. 9 is a DC-DC converter which considers the electrical potential difference of an electric double layer capacitor 2 as an input, and this converter is the thing of the switching elements 4 for voltage adjustment, such as FET and a bipolar form transistor, diode 5, the capacitor 6 for smooth, a transformer 7, and the pulse width control system that comes to interconnect like illustration of control circuit 8 grade.

[0024] If actuation of the power unit of drawing 1 is explained, the rechargeable battery 1 will be separately charged beforehand according to the power source in the condition of having separated from the circuit. If a switch 3 is turned ON, a current will flow from a rechargeable battery 1 to an electric double layer capacitor 2, and a capacitor 2 will be charged. An electric double layer capacitor 2 has an extraordinarily large capacity compared with the electrolytic capacitor which used the dielectric, and since it exists in extent which cannot disregard internal resistance, either, charge takes the time amount for several minutes to it from several seconds. turning on and off of the switching element 4 for voltage adjustment from which the output of an electric double layer capacitor 2 consists of FET at the time of discharge -- pulse current -- becoming -- this pulse current -- a transformer 7 -- a pressure up -- or the pressure is lowered. And it is rectified by the rectification smoothing effect of diode 5 and the capacitor 6 for smooth, and the output of a transformer 7 turns into a pressure up or a dc output whose pressure was lowered to a fixed electrical potential difference required for a load. A control circuit 8 detects this direct-current output voltage, changes the duty ratio of the output pulse of a switching element 4, and outputs the control signal controlled to keep direct-current output voltage constant. Thereby, operating voltage width of face of an electric double layer capacitor 2 can be enlarged, and the electrical energy which the capacitor 2 is storing can be used effectively.

[0025] However, if there is a limitation in carrying out constant-voltage control of the above-mentioned direct-current output voltage and the stored charge of an electric double layer capacitor 2 decreases in number below to some extent, output voltage will come to decrease gradually from constant value. The output current also comes to decrease along with this. A control circuit 8 suspends the output of the control signal

to a switching element 4, in order to make DC-DC converter 9 into non-operating state, if it detects that output voltage began to decrease from constant value. After making DC-DC converter 9 into non-operating state and completing the discharge from an electric double layer capacitor 2, a current is completely supplied to Load L from a rechargeable battery 1. When DC-DC converter 9 is in operating state and a switching element 4 is in an OFF state, a capacitor 2 is charged by the rechargeable battery 1. Moreover, an electric double layer capacitor 2 is charged by the rechargeable battery 1 at the period when DC-DC converter 9 is non-operating state. Thereby, the recharge of the electric double layer capacitor 2 is carried out, and it becomes again usable.

[0026] A power unit as shown in drawing 1 is effectively used, when supplying sufficient starting power for a motor through DC-DC converter 9 like [ in the case of starting the motor of an electric vehicle ] from the electric double layer capacitor 2 with high power density first when you need big power for the inside of a short time, and mainly supplying necessary drive power from a rechargeable battery 1 after starting. By selecting the property of DC-DC converter 9 suitably, the correlation function of the electric power supply to Load L can be set up like [ to some extent ] a request from an electric double layer capacitor 2 and a rechargeable battery 1. It becomes the power unit which combines the features of a rechargeable battery 1 excellent in the energy density, and the features of an electric double layer capacitor 2 excellent in power density by this.

[0027] In the power unit of drawing 1 , since parallel connection of a rechargeable battery 1 and the electric double layer capacitor 2 is carried out, a capacitor 2 is in the condition in which a recharge is always possible from a rechargeable battery 1. In this example, also when discharge of a capacitor 2 is completed, a rechargeable battery 1 carries out discharge starting, and a full load is to some extent large, it may happen [ since especially the charging current of a capacitor 2 is not controlled, ] that a part of discharge current of a rechargeable battery 1 will be used for charge of a capacitor 2. Therefore, the effectiveness of a hybrid power source may not show up enough.

[0028] Drawing 2 is the example which canceled this fault. This adds the switching elements 10 for charge control, such as FET and a bipolar mold transistor, to the circuit for charge, in order to control the charging current. The charge control means to which a part of control circuit 8a chopper-controls charge of a capacitor 2 using the switching element 10 which consists of FET consists of this example. That is, the

charging current is controlled by turning on and off the switching element 10 of a charge circuit at high speed, and changing the rate of ON time amount to off time amount. If the rate of ON time amount is large, the load of the charge for a rechargeable battery 1 will become large. When a switching element 10 is in the condition of OFF, an electric double layer capacitor 2 is not charged from a rechargeable battery 1.

[0029] Then, if a switching element 10 is made into an ON state and a capacitor 2 is charged with a rechargeable battery 1 at this time since the discharge from a capacitor 2 has stopped when a switching element 4 is in an OFF state, a capacitor 2 can be charged, without affecting discharge from a capacitor 2. The charge control means which controls turning on and off of a switching element 10 is included in control circuit 8a in drawing, and when the load of discharge is small, charge of a capacitor 2 is made [ many ], and this charge control means controls a switching element 10 to lessen charge of a capacitor 2, when the load of discharge is large.

[0030] Although some methods of realizing this are considered, the easy and effective control approach is described below. As shown in drawing 6 , as for DC-DC converter 9, the rate of ON time amount to the OFF time amount of DC-DC converter 9 changes with the magnitude of the load L of discharge. That is, when large (at the time of a heavy load), the rate of the ON time amount of a switching element 4 becomes [ Load L ] large, and when small (at the time of low loading), the rate of the ON time amount of a switching element 4 becomes [ Load L ] small. When DC-DC converter 9 is in operating state using this and the switching element 4 for voltage adjustment of DC-DC converter 9 is in an ON state, the switching element 10 for charge control is made into an OFF state, and when the switching element 4 for voltage adjustment is in an OFF state, the charge control means included in control circuit 8a outputs a control signal so that the switching element 10 for charge control may be made into an ON state. The inverter circuit which used the comparator etc. can constitute the charge control means which outputs such a control signal. That is, it constitutes so that the wave which reversed the control signal outputted to the switching element 4 of a DC-DC converter by the inverter circuit may be outputted as a control signal of a switching element 10. That is, when the switching element 4 for voltage adjustment of DC-DC converter 9 is in an ON state, the switching element 10 for charge control is made into an OFF state, and when a switching element 4 is in an OFF state, it controls to make a switching element 10 into an ON state. By carrying out like this, when the

rate of ON time amount is large, the rate of the ON time amount of the charging current becomes small, and when the rate of ON time amount is small, it can control by the pulse control system of DC-DC converter 9 so that the rate of the ON time amount of the charging current becomes large. Consequently, when the full load of discharge is large, the electric double layer capacitor 2 excellent in power density discharges alternatively, and when the full load of discharge is small, an electric double layer capacitor 2 will be effectively charged from a rechargeable battery 1. Moreover, while making continuously the switching element 4 for voltage adjustment of DC-DC converter 9 into an OFF state and supplying power to Load L from the rechargeable battery 1, a switching element 10 will be in an ON state, and a capacitor 2 is completely charged by the rechargeable battery 1.

[0031] In addition, in the example of drawing 3 , although diode 11 is added to the charge circuit of a capacitor 2, by carrying out like this, the discharge current from an electric double layer capacitor 2 will pass only along DC-DC converter 9, without passing along a charge circuit, and an electric double layer capacitor 2 can discharge to a lower electrical potential difference, and it can heighten the effectiveness of a hybrid power source more.

[0032] Although this invention showed constituting the hybrid power unit which used together the rechargeable battery and the electric double layer capacitor from above examples, the configuration for considering as the further excellent hybrid power unit is shown below. In the example of drawing 4 , parallel connection is carried out to a DC-DC converter output through diode 12 at a rechargeable battery 1. Although the electrical-potential-difference change under discharge has few rechargeable batteries 1, an electrical potential difference falls gradually as there is not necessarily nothing at all and it discharges. When parallel connection of the output of a rechargeable battery 1 and DC-DC converter 9 is carried out simply and the electrical potential difference of a rechargeable battery 1 becomes low from the output of DC-DC converter 9 at the time of discharge, it is possible that a current flows into a rechargeable battery. Moreover, the difficulty which flows backwards in part also has the starting current of the motor used as a load L in a rechargeable battery 1. It can prevent a current flowing into a rechargeable battery 1 by carrying out like drawing 4 . In addition, since diode is built into the interior of DC-DC converter 9, a reverse phenomenon does not happen.

[0033] next, a rechargeable battery 1 and an electric double layer capacitor 2 -- while

being able to perform the electric power supply to the load of a twist good, respectively, drawing 5 explains other examples of this invention which can carry out the recharge of the electric double layer capacitor 2 good. 4' of drawing 5 is a switching element for voltage adjustment, and a control circuit where a transformer and 8b have [ 5' ] a charge control means in diode and 7', and these interconnect like illustration with the capacitor 6 for smooth, and constitute 2nd DC-DC converter 9'. Other configurations are the same as the thing of drawing 2 . That is, in the example of drawing 5 , the power of a rechargeable battery 1 is supplied to Load L through DC-DC converter 9' controlled so that output voltage becomes fixed. Control circuit 8b outputs the control signal for controlling DC-DC converter 9'. Thereby, the current supplied to Load L from a rechargeable battery 1 becomes fixed unless Load L changes. In addition, while one side is operating, control circuit 8b and control circuit 8a are constituted so that another side may suspend actuation. Therefore, two DC-DC converters do not operate to coincidence.

[0034] On the other hand, the power from an electric double layer capacitor 2 as well as the above-mentioned example is supplied to Load L through 1st DC-DC converter 9. That is, in the example of drawing 5 , while being able to make good use effectiveness of the power of an electric double layer capacitor 2, the use effectiveness of the power of a rechargeable battery 1 is also improvable. Moreover, the correlation of the electric power supply to Load L can be set up like [ to some extent ] a request from a capacitor 2 and a rechargeable battery 1 by selecting suitably 1st and 2nd DC-DC converters 9 and each output voltage property of 9'.

[0035] Furthermore, in the example of drawing 5 , when 1st DC-DC converter 9 is in operating state and the switching element 4 for voltage adjustment is in an ON state like the example of drawing 2 , the switching element 10 for charge control is made into an OFF state, and when the switching element 4 for voltage adjustment is in an OFF state, a control signal is outputted from the charge control means of control circuit 8a so that the switching element 10 for charge control may be made into an ON state. Moreover, when 2nd DC-DC converter 9' is in operating state and switching element 4' for voltage adjustment is in an ON state, the switching element 10 for charge control is made into an OFF state, and when switching element 4' is in an OFF state, a control signal is outputted from the charge control means of control circuit 8b so that a switching element 10 may be made into an ON state. As above-mentioned, control circuit 8b outputs a control signal, when control circuit 8a is in non-operating

state. The charge control means of control circuit 8b outputs the reversal signal of the control signal of switching element 4' as a control signal of a switching element 10 like the charge control means included in control circuit 8a explained in the example of drawing 2 . The charge control means specified by the claim is constituted from this example by two charge control means included in control circuits 8a and 8b, respectively. If it does in this way, charge actuation of the electric double layer capacitor by the rechargeable battery will not affect the electric power supply to a load.

[0036]

**[Effect of the Invention]** The electrical potential difference impressed to a load since power was supplied to the load from the electric double layer capacitor through the DC-DC converter controlled so that output voltage becomes fixed with the power unit with which an electric double layer capacitor is charged by the rechargeable battery according to [ as stated above ] the power unit of this invention, including an electric double layer capacitor and a rechargeable battery as a power source can be maintained on a a certain amount of period predetermined electrical potential difference, and the current of a a certain amount of period [ from an electric double layer capacitor to a load ] predetermined value can be supplied. Thereby, discharge use of the stored charge of an electric double layer capacitor can fully be carried out. And after ending the discharge from an electric double layer capacitor, while being able to supply electric power to a load appropriately with a rechargeable battery, the recharge of the electric double layer capacitor can be carried out certainly. Therefore, according to this invention, the power unit which was excellent in responsibility to the load changed using appropriately both rechargeable battery of a high energy consistency and electric double layer capacitor of high power density can be obtained. Moreover, since the load concerning a rechargeable battery can be equalized to the load to change, there is also an advantage that the life of a rechargeable battery improves. [0037] Moreover, according to the power unit of this invention, an electric double layer capacitor can discharge, without being influenced of a rechargeable battery. Moreover, an electric double layer capacitor can be charged, without affecting discharge from an electric double layer capacitor. Furthermore, the recharge of the electric double layer capacitor can be carried out, without affecting supply of the

power. from a rechargeable battery to a load.

## CLAIMS

[Claim(s)]

[Claim 1] The power unit which is a power unit with which said electric double layer capacitor is charged by said rechargeable battery including an electric double layer capacitor and a rechargeable battery as a power source, and is characterized by supplying power to a load from said electric double layer capacitor through the DC-DC converter controlled so that output voltage becomes fixed.

[Claim 2] Said electric double layer capacitor is charged by said rechargeable battery including an electric double layer capacitor and a rechargeable battery as a power source. It is the power unit which supplies power to a load from said electric double layer capacitor through the DC-DC converter controlled so that output voltage becomes fixed. The charge circuit which charges said electric double layer capacitor by using said rechargeable battery as a power source Turn on and off according to the control signal outputted from a charge control means, and the switching element for charge control which passes the charging current at said electric double layer capacitor is included in the "on" period from said rechargeable battery. Without checking that said charge control means supplies power to said load from said electric double layer capacitor through said DC-DC converter The power unit characterized by outputting said control signal so that said switching element for charge control may be made to turn on and off and said charging current can be passed from said rechargeable battery to said electric double layer capacitor.

[Claim 3] Said electric double layer capacitor is charged by said rechargeable battery including an electric double layer capacitor and a rechargeable battery as a power source. It is the power unit which supplies power to a load from said electric double layer capacitor through the DC-DC converter controlled so that output voltage becomes fixed. The switching element for voltage adjustment by which on-off control is carried out since said DC-DC converter fixes said output voltage is included. The charge circuit which charges said electric double layer capacitor by using said

rechargeable battery as a power source Turn on and off according to the control signal outputted from a charge control means, and the switching element for charge control which passes the charging current at said electric double layer capacitor is included in the "on" period from said rechargeable battery. Said charge control means makes an OFF state said switching element for charge control, when said switching element for voltage adjustment of said DC-DC converter is in an ON state. The power unit characterized by outputting said control signal so that said switching element for charge control may be made into an ON state, when said switching element for voltage adjustment is in an OFF state.

[Claim 4] Said control signal outputted from said charge control means is the control signal which controls said switching element for voltage adjustment, and a power unit according to claim 3 which the phase has reversed.

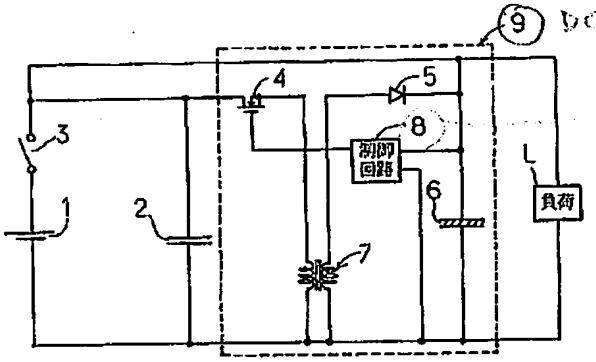
[Claim 5] Said charge control means is a power unit according to claim 3 characterized by outputting said control signal with which the ON state of said switching element for charge control becomes short, and the ON state of said switching element for charge control becomes long when said discharge current is small when the discharge current which flows for said load from said rechargeable battery when said DC-DC converter is in non-operating state is large.

[Claim 6] Said electric double layer capacitor is charged by said rechargeable battery including an electric double layer capacitor and a rechargeable battery as a power source. Power is supplied to a load from said electric double layer capacitor through the 1st DC-DC converter controlled so that output voltage becomes fixed. Power is supplied to a load from said rechargeable battery through the 2nd DC-DC converter controlled so that output voltage becomes fixed. It is the power unit which operates alternatively said the 1st DC-DC converter and 2nd DC-DC converter. The switching element for voltage adjustment by which on-off control is carried out in order that said 1st and 2nd DC-DC converters may make said output voltage regularity is included, respectively. The charge circuit which charges said electric double layer capacitor by using said rechargeable battery as a power source Turn on and off according to the control signal outputted from a charge control means, and the switching element for charge control which passes the charging current at said electric

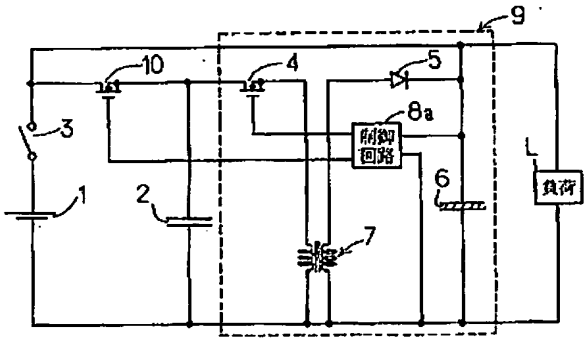
double layer capacitor is included in the "on" period from said rechargeable battery. When said 1st DC-DC converter is in operating state, said charge control means When said switching element for voltage adjustment of said 1st DC-DC converter is in an ON state, said switching element for charge control is made into an OFF state. Said control signal is outputted so that said switching element for charge control may be made into an ON state, when said switching element for voltage adjustment is in an OFF state. When said 2nd DC-DC converter is in operating state When said switching element for voltage adjustment of said 2nd DC-DC converter is in an ON state, said switching element for charge control is made into an OFF state. The power unit characterized by outputting said control signal so that said switching element for charge control may be made into an ON state, when said switching element for voltage adjustment is in an OFF state.

DRAWINGS

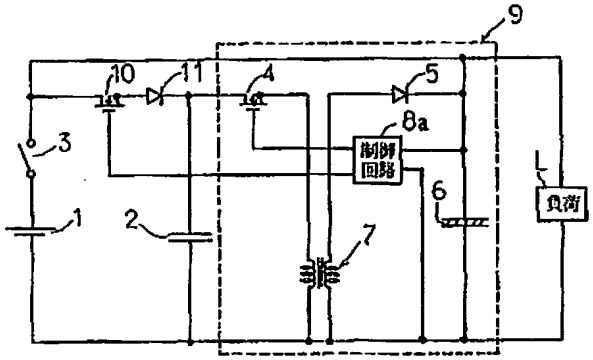
[Drawing 1]



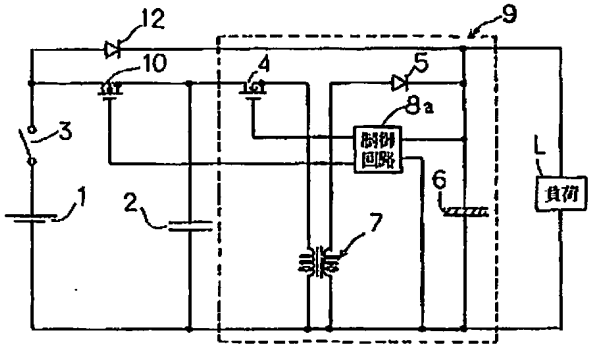

[Drawing 2]



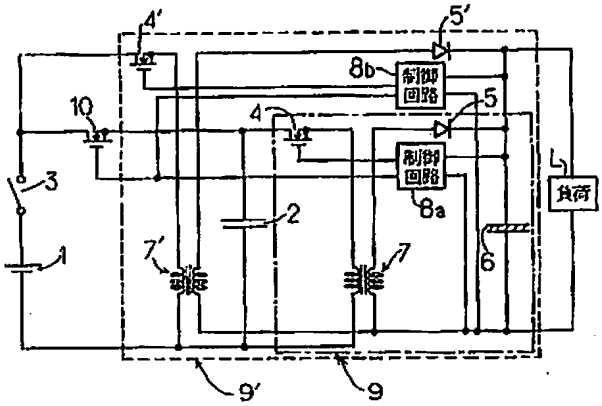
[Drawing 3]



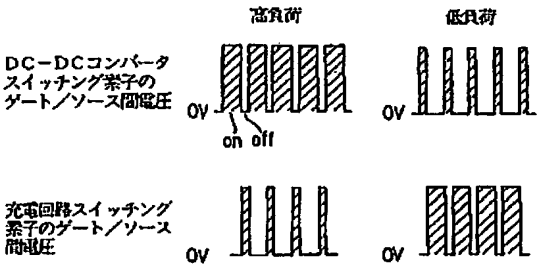

[Drawing 4]




[Drawing 5]



[Drawing 6]


高負荷
低負荷
DC－DCコンバータ
スイッチング素子の
ゲート／ソース間電圧
0V
on
off
0V
充電回路スイッチング
素子のゲート／ソース
間電圧
0V
0V